

WHAT IS CLAIMED IS:

1. An apparatus comprising:

a first spring made from a shape-memory material;

a first heating element for heating said first spring;

a second spring:

a pin urged in a first direction by said first spring after said first spring is heated, said pin being urged in a second direction by said second spring, the first direction being generally opposite of said second direction; and

a member with a surface, the member including a hole;

wherein a portion of said pin passes through the hole and extends beyond the surface after said first spring is heated.

2. The apparatus of claim 1 wherein said first spring is a compression coil spring.

3. The apparatus of claim 1 wherein said first spring is a tension coil spring.

4. The apparatus of claim 1 wherein said second spring is made from a shape-memory material, and which further comprises a second heating element for heating said second spring.

5. The apparatus of claim 4 wherein said second spring is a compression coil spring.

6. The apparatus of claim 4 wherein said second spring is a tension coil spring.

7. The apparatus of claim 1 wherein said first heating element is a thermoelectric generator.

8. The apparatus of claim 7 wherein said first spring is a coil spring with two ends, an outer diameter, an inner diameter, and an interior.

9. The apparatus of claim 8 wherein said thermoelectric generator is in contact with one end of said first spring.

10. The apparatus of claim 9 wherein said thermoelectric generator has an outer diameter that is less than the inner diameter of said first spring, and a portion of said thermoelectric generator is within a portion of the interior of said first spring.

11. The apparatus of claim 9 wherein said thermoelectric generator has an inner diameter that is greater than the outer diameter of said first spring, and a portion of said thermoelectric generator surrounds a portion of said first spring.

12. The apparatus of claim 1 wherein said first heating element is a resistance heater.

13. An apparatus comprising:
a first spring made from a shape-memory material;
an electrical power supply constructed and arranged for resistively heating said first spring by passing electrical current through said first spring;
a second spring;
a member with a surface, said member defining a hole;
a pin urged in a first direction by said first spring after said first spring is heated, said pin being urged in a second direction by said second spring, the first direction being generally opposite of said second direction, said pin having a first position wherein a portion of said pin passes through the hole and extends beyond the surface; and
a supporting mechanism for supporting said pin in the first position.

14. The apparatus of claim 13 wherein said first spring is a compression coil spring.

15. The apparatus of claim 13 wherein said second spring is made from a shape-memory material, and said second spring is heated by said electrical power supply.

16. The apparatus of claim 15 wherein said second spring is a compression coil spring.

17. An apparatus for displaying a braille character comprising:

a member with a surface, the member defining at least six holes;

at least six actuators, each said actuator including a pin, a shape-memory spring for urging the pin in a direction, and a thermoelectric heater to heat said spring; and

an electrical circuit for receiving an input electrical signal, said electrical circuit being in electrical communication with said heaters, said heaters being operable to heat in response to an output signal from electrical circuit;

wherein said pin of each said actuator is aligned with a hole, a portion of said pin being capable of passing through a hole and extending beyond the surface in response to heating by one of said heaters.

18. The apparatus of claim 17 wherein said springs are compression coil springs.

19. The apparatus of claim 18 which further comprises at least eight actuators configured and adapted to display a braille character.

20. A system comprising:

a processor operating a program with a user interface, said processor having an output electrical signal corresponding to the user interface; and

a haptic display comprising a plurality of actuators, each said actuator including a pin capable of extending and retracting, a shape-memory spring for urging the pin in a direction, and a thermoelectric heater to heat said spring, said display including an electrical circuit for receiving the output electrical signal, said electrical circuit being in electrical communication with said heaters and operable to cause said heaters to heat said springs in response to the output signal;

wherein some of said pins of said display extend in a pattern in response to the output signal, the pattern corresponding to the user interface.

21. The system of claim 20 which further comprises a clock, wherein the user interface is the time or the date.

22. The system of claim 20 which further comprises an automated teller machine, wherein the user interface includes financial data.

23. The system of claim 20 wherein said actuator includes a supporting mechanism for maintaining said pin in the extended position.

24. An apparatus comprising:

a pin having two ends, said pin having a projection intermediate of the two ends, said pin having a first position;

a first spring for urging said pin toward the first position, said first spring being fabricated from a shape-memory material;

a member defining a guide slot for said projection, said guide slot including a first rest for said projection such that the first rest supports said pin in the first position; and

a heater for heating said first spring;

wherein said first spring urges said pin toward the first position in response to a first heating of said first spring.

25. The apparatus of claim 24 wherein said pin has a second position and said guide slot defines a second rest for said projection such that the second rest supports said pin in the second position.

26. The apparatus of claim 25 wherein said pin is used for displaying tactile braille symbols, and the first position is an extended position and the second position is a retracted position.

27. The apparatus of claim 25 wherein said pin moves from the first position to the second position after a second heating of said first spring.

28. The apparatus of claim 24 which further comprises a second spring for urging said pin away from the first position.

29. An apparatus comprising:

a first pin having a first position;

a second pin having two ends and a projection intermediate of the two ends;

a first spring constructed and arranged for biasing said first pin and said second pin toward the first position, said first spring being fabricated from a shape-memory material;

a member defining a guide slot for said projection, said guide slot including a first rest for supporting said projection such that the first rest supports said projection when said first pin is in the first position; and

a heater for heating said first spring;

wherein said first spring urges said first pin toward the first position in response to a first heating of said first spring.

30. An apparatus comprising:
a pin having a first position;
a spoked member having a plurality of long sections;
a first spring for biasing said pin toward the first position, said first spring being fabricated from a shape-memory material;

a member including a rest and a channel arranged around the circumference of a hole, said rest supporting a long section when said pin is in the first position; and

a heater for heating said first spring;

wherein said first spring urges said first pin toward the first position in response to a first heating of said first spring.

31. The apparatus of claim 30 wherein said spoked member includes a first plurality of teeth, and which further comprises a contact member with a second plurality of teeth, urging of said contact member toward the first position results in engagement of the first plurality of teeth with the second plurality of teeth.

32. The apparatus of claim 30 wherein said spring is a compression coil spring.

33. The apparatus of claim 30 wherein said heater is a thermoelectric heater.

34. A method comprising:

providing a shape-memory spring, a pin with a projection, a member with a guide slot, and a return spring;

heating the spring;

urging of the pin by the spring toward a first position;

cooling of said spring after said urging; and

supporting the pin by the projection within a rest of the guide slot.

35. The method of claim 34 wherein said providing includes a second spring, and which further comprises urging of the pin by the second spring toward the rest during said supporting.

36. The method of claim 34 which further comprises:

heating said spring after said supporting;

a second urging of the pin by the spring such that the projection moves away from the rest;

37. The method of claim 36 which further comprises:

cooling after said second urging;

supporting the pin at a second position, the second position being different than the first position.

38. An apparatus comprising:

a first spring fabricated from a shape memory material;

a first pin having a projection, said first pin being urged in a first direction by said first spring;

a member including a first guiding surface and a second guiding surface, each surface being adapted for sliding contact with said projection, the first guiding surface including a first rest, said member defining two channels; and

a heater for heating said first spring, wherein said heater is capable of applying a first amount of heat to said first spring and a second amount of heat to said first spring, the second amount being greater than the first amount;

wherein said projection moves from the first channel and along the first guiding surface to the first rest in response to heating said first spring by a first amount, and said projection moves from the first channel along the second guiding surface to the second channel in response to heating said first spring by a second amount.

39. The apparatus of claim 38 which further comprises a second spring for urging said first pin in a second direction generally opposite the first direction.

40. The apparatus of claim 38 which further comprises a second pin and a third pin, said first pin being intermediate of said second pin and said third pin.

41. The apparatus of claim 40 wherein said second pin represents a portion of a haptic braille display.

42. The apparatus of claim 38 wherein said first pin has an end with a first plurality of teeth, said second pin has an end with a second plurality of teeth, said first plurality of teeth being engageable with said second plurality of teeth.

43. The apparatus of claim 38 wherein said projection moves from the first rest to a channel in response to heating said first spring by the first amount or the second amount.

44. A method comprising:

providing a coil spring with a first outer diameter and a first length fabricated from a shape memory material;

providing a member defining a chamber with an inner diameter and a length, the chamber length being greater than the length of the spring and the chamber inner diameter being greater than the outer diameter of the spring;

placing the spring in the chamber;

heating the chamber and spring to more than about 400 degrees C. and less than about 600 degrees C. for a period of more than about two minutes; and

permitting the spring outer diameter to grow to the inner diameter of the chamber, and permitting the spring length to grow to the length of the chamber.

45. The method of claim 44 which further comprises:

heating the chamber and spring after said permitting to more than about 900 degrees C. for a period of less than about ten seconds; and

quenching the chamber and spring in water.

46. The method of claim 44 which further comprises:

removing the spring from the chamber after said permitting; putting the spring in a fuel rich flame for more than about one second and less than about five seconds, said putting being after said removing.

47. The method of claim 46 which further comprises

quenching the spring in water after said putting.

48. An apparatus comprising:

a coil spring fabricated from a shape memory material, said spring having a first section and a second section; and

an electrical power supply having a first circuit for heating the first section and a second circuit for heating said second section;

wherein said spring exhibits a first response to heating the first section, a second response to heating the second section, and a third response to heating the first section and the second section, the third response being different than the first response or the second response.

49. The apparatus of claim 48 wherein said first section has a first number of coils, said second section has a second number of coils, and the first number is different than the second number.

50. The apparatus of claim 49 wherein the coils of said first section have a first pitch, the coils of the second section have a second pitch, and the first pitch is different than the second pitch.

51. The apparatus of claim 49 wherein said first section has a first outer diameter, said second section has a second outer diameter, and the first outer diameter is different than the second outer diameter.

52. The apparatus of claim 48 which further comprises a pin urged in a direction by said spring, said pin representing a portion of a braille display.

53. The apparatus of claim 48 wherein said spring is a compression coil spring.

54. The apparatus of claim 48 wherein said first circuit heats said first section by passing current through the first section, and said second circuit heats said second section by passing current through the second section.

55. The apparatus of claim 48 which further comprises a first heater for heating said first section and a second heater and a second heater for heating said second section, said first heater being proximate to said first section and said second heater being proximate to said second section.

56. The apparatus of claim 55 wherein said first heater is a resistance heater.

57. The apparatus of claim 55 wherein said first heater is a thermoelectric heater.

58. An apparatus comprising:

a first spring made from a shape-memory material;

a capacitive discharge electrical power supply for heating said first spring, said power supply being constructed and arranged for passing electrical current through said first spring;

a second spring:

a member with a surface, said member defining a hole;

a pin urged in a first direction by said first spring after said first spring is heated, said pin being urged in a second direction by said second spring, the first direction being generally opposite of said second direction, said pin having a first position wherein a portion of said pin passes through the hole and extends beyond the surface when said first spring is heated by said power supply.

59. An apparatus comprising:

a first spring made from a shape-memory material;

a thermoelectric heating element for heating and cooling said first spring;

a pin urged in a first direction by said first spring when said first spring is heated;

an electrical power supply for providing electrical power with a first polarity to said thermoelectric heater; and

an inverter for reversing the polarity of the power provided to said thermoelectric heater;

wherein said thermoelectric heater heats said spring in response to receiving electrical power of one of the first polarity or the reversed polarity and cools said spring in response to receiving electrical power of the other of the first polarity or the reversed polarity.

60. The apparatus of claim 59 wherein said pin has a first position, and which further comprises a support mechanism for supporting said pin in the first position.

61. The apparatus of claim 59 wherein said first spring is a compression coil spring.

62. The apparatus of claim 59 which further comprises a second spring for urging said pin in a second direction.

63. The apparatus of claim 62 wherein said second spring is made from a shape-memory material, and which further comprises a second heating element for heating said second spring.